Simple analytical solutions to quantify colloidal stability and reducing reactivity of nanoscale zero-valent iron

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**N.B.* – Authors are invited to signal corrections in the mean time to improve this draft.

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Biography

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Simple analytical solutions to quantify colloidal stability and reducing reactivity of nanoscale zero-valent iron

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Abstract

Nanoscale zero-valent iron (nZVI) has been effectively applied for environmental remediation due to its great ability to reduce different types of toxic compounds [1]. A number of different nZVI materials have been prepared and compared across many intensive studies, in order to obtain better properties for environmental application, thus development and standardization of analytical methods to characterize them in terms of colloidal stability and reducing reactivity should be emphasized. Even though advanced chromatographic and spectroscopic techniques have been applied as the predominant method to characterize nZVIs, it generally requires lengthy analysis procedures and complicated set-ups. In this light, simple and versatile analytical solution for use in general laboratories to quantify nZVI characteristics is developed in this study. The colloidal stability and reducing reactivity of nZVIs was characterized using only a basic spectrophotometer, and it was compared with advanced analytical methods to verify effectiveness of suggested methods.

Colloidal stability of nZVI was determined by monitoring sedimentation of diluted nZVI dispersion as a function of time using a UV-Vis spectrophotometer. The obtained sedimentation curves were further interpreted using the Stoke's law to calculate hydrodynamic radius of the aggregates. The results were compared with particle size and surface charge obtained by dynamic laser light scattering equipment. Even though the sensitivity was different in both methods, the overall trend was greatly identical, which showed very high positive linear relationship ($R^2 = 0.9855$, $p < 0.0001$) [2].

The modified indophenol method was suggested to determine reducing reactivity of nZVI. The method was originally developed for determining aqueous ammonia concentration, but it was further modified to quantify phenol and aniline [3]. The assay focused on analysis of reaction products rather than its mother compounds, which gives more accurate quantification of reductive activity. The colorimetric assays were developed to quantify three reaction products, ammonia, phenol, and aniline, generated as results of reduction of nitrate, halophenols, and nitrobenzene, respectively. The use of same reagents and monitoring same color product ($\lambda = 680$ nm) provides simplicity and versatility to the color reactions. The

colorimetric assays were further miniaturized and optimized into 96-well microplate having 230 μL of sample volume and 2 h of reaction time. The three groups of compounds, nitrate, nitrobenzene, and para-positioned halogenated phenols, showed graduated reactivity, and thus reduction potency and kinetics of different materials and reaction mechanism was well distinguished. The obtained nZVI's reactivity was well agreed with the result obtained by advanced analytical techniques.
Therefore, the suggested quantification procedure for nZVI characteristics using simple spectrophotometer promises to be a useful and simple tool in various nZVI related research topics.

Keywords: *Nanoscale zero valent iron; Colloidal stability; Dehalogenation reactivity; Colorimetric assay; Multiwell microplate*

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Biography

Yuhoon Hwang is currently a researcher (assistant professor level) at Department of Environmental Engineering in Technical University of Denmark. He obtained his Ph. D in Department of Civil and Environmental Engineering in KAIST in 2012. His major research topic is the environmental application of engineered nano materials, specifically, nano-scale zero valent iron (nZVI). Moreover, he is working on various advanced water treatment technologies, e.g. membrane based water treatment, advanced oxidation process, etc.

Highly Active and Durable Co-N-C Electrocatalyst Synthesized Using Exfoliated Graphitic Carbon Nitride Nanosheets

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Abstract

Polymer electrolyte membrane fuel cells (PEMFCs) are of great interests as an alternative power generation process that substitute fossil fuel based current energy economy because of environmental-friendly nature that produce water as the only byproduct and high energy